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ABSTRACT

This report presents findings from a project to gather from pilot Certificate of Pre-Vocational Education (CPVE) programs in Great Britain examples of ways in which teachers had or were intending to approach the Science and Technology objectives. (The CPVE framework consists of 10 core areas, one of which is Science and Technology.) It is intended as an aid to teachers in the planning and delivery of CPVE. Section 1 describes the project. Section 2 provides a rationale for including Science and Technology in the core. It considers how the Science and Technology aims can be interpreted. Section 3 suggests possible strategies for covering the Science and Technology objectives. Constraints are first discussed, since the strategies that are possible depend largely on the constraints. Suggested strategies start with the situation where organizational constraints restrict the range of activities available and proceed to consideration of more open activities, such as assignments and projects. Section 4 discusses examples grouped under the classification of strategies considered in Section 3, namely, timetabled Science and Technology, within wide-coverage assignments, and within major products. Section 5 provides a checklist to assist the teacher in relating to students' needs and CPVE as a whole. (YLB)

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A Project Report

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SUPPORTING SCIENCE AND TECHNOLOGY IN CPVE

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SUPPORTING SCIENCE AND TECHNOLOGY IN CPVE

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Dear Sir/Madam,

SUPPORTING SCIENCE AND TECHNOLOGY IN CPVE

Enclosed is a copy of the above publication. It is the work of a group of expert practitioners brought together by the FEU and chaired by FEU Consultant, Bill Bolton. Their task was to follow up a significant message from the CPVE pilot courses, evaluated by FEU in 1985*. The message was that the teachers, and therefore their students, did not in general understand what they were supposed to be doing under the CPVE Science and Technology core aims and objectives (see Appendix I), and consequently were not convinced of their relevance. (A similar, but less surprising message was received with respect to IT in CPVE, and we have responded to this elsewhere**.)

One of the problems arising from the Science and Technology aims and objectives is that they emphasise processes and skills rather than factual knowledge. Developing appreciation, understanding, facility and a critical approach is a familiar enough vocabulary for those who promote education, but actually teaching these processes within the context of a 'hard' subject is a different matter. Add to this the other problem of combining technology with science, and taking on board these issues as part of a compulsory core, and the agenda for the project and its steering group is more or less described.

The report therefore identifies the issues and attempts to answer the questions that teachers asked during the pilots: Why should science and technology be in the core? What do the objectives mean? How can they be delivered? Sections 1 and 2 apply to the first two questions and, not unexpectedly, the work of the Secondary Science Curriculum Review is referred to in this context.

The bulk of the report, however, comprises sections 3 and 4 which attempt to answer the third question by suggesting strategies and giving examples. The strategies that are possible depend largely on the constraints. Inflexible timetables are no less a problem in science and technology than in other subjects where active learning methods are to be encouraged. Similarly, the suggested strategies of learning through assignments and/or projects are not unique to science and technology, although the document makes it pretty clear that they are necessary if these particular objectives are to be fulfilled.

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* CPVE in Action, FEU, November 1985.
** Supporting IT in CPVE, FEU, May 1986.

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The examples in section 4, which relate to taught skills, assignments and projects, are taken from actual practice. They are not perfect, reflecting as they do the real constraints; thus they provide a series of ideas rather than a prescription. The ways in which assignments and projects overlap with other areas of the core, questions leading to possible experiments, cautionary messages about linking too closely with occupational skills, applications to caring, business, leisure and production, mini-companies and residentials, etc. should provide a useful resource for all teachers, and particularly help those who asked for guidance in delivering science and technology to students who cannot immediately perceive its relevance to their needs.

The final section reminds teachers that any strategy has to be resourced and properly administered. A checklist is provided to assist the teacher in relating to students' needs and to CPVE as a whole. Final words of advice stress integration and team working, and urge teachers to take a wide view of what constitutes science and technology.

Yours faithfully,

Jack Mansell

JACK MANSELL
Chief Officer

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SECTION 1 - INTRODUCTION

The CPVE pilot experience

1. Following the publication by the Joint Board for Pre-Vocational Education of a Consultative Document[1] outlining the ideas on which the Certificate of Pre-Vocational Education (CPVE) was to be based, 15 groups of schools and/or colleges involving 52 institutions ran pilot CPVE programmes during 1984/5. The Further Education Unit, as part of the DES funded support programme, carried out a supportive evaluation. The outcomes of that evaluation have been published as CPVE in Action.[2]

2. The three components of the CPVE framework are the Core, Vocational Studies and Additional Studies; the Core and Vocational Studies occupying a minimum of 75% of the course time. The Core is described in terms of a range of experiences and competences which are deemed essential to the students' chances of making a success in adult life, including work. The Joint Board expect that the Core will be used:

   a) as a checklist against which previous achievements can be matched in order to define starting-points for learning on a CPVE course;

   b) as a checklist against which students' achievements within the course can be matched to provide a basis for recording progress and for preparing final reports on attainment;

   c) as a resource from which objectives can be drawn to build into courses according to student need.[3]

3. The CPVE framework consists of ten core areas, one of which is Science and Technology.[4] This is specified in terms of what might be called 'process', rather than 'content' aims and objectives. Figure 1 gives the aims of this area.

The Joint Board documentation lists objectives under each aim (see Appendix I).

4. The inclusion of science and technology in the core and its specification in terms of 'process' objectives presented teachers with difficulties of interpretation. In addition, some teachers clearly felt that, for some students, this core area had little relevance. This was particularly a problem in relation to students with commerce/business interests. There was some evidence in the evaluation[2] that this perceived lack of relevance stemmed from a misunderstanding of, or lack of clarity in, the objectives set by the Joint Board. The evaluation also pointed to difficulties in involving teachers with science skills in the CPVE team, and in making appropriate equipment and facilities available.

5. In summary, teachers were asking the following questions:
   a) Why should science and technology be in the core?
   b) What is meant by the science and technology objectives?
   c) How can the objectives be delivered?

FIGURE 1

CPVE Science and Technology Aims

Main Aim: To develop understanding of science and technology, and their relationship to everyday life, and competence in the application of practical, scientific method.

Aim 1: Appreciation of science and technology.

To develop appreciation of science and technology, their relationship with society and the environment and awareness of moral and legal implications.

Aim 2: Application of science and technology to problems.

To develop a critical approach and an ability to apply principles, reasoning and skills to problems and issues of everyday life.

Aim 3: Science.

To develop facility in using scientific methods to conduct investigations and evaluate their outcomes.

Aim 4: Technology.

To develop understanding of the processes of planning, implementing and evaluating technological activities.

The project

6. Following a discussion of the difficulties experienced by the pilots, the FEU established a short project to provide assistance to teachers and feedback to the Joint Board for Pre-Vocational Education. This report is the outcome of the project.

7. The method adopted for the project was to gather as widely as possible from within the pilots examples of ways in which teachers had or were intending to approach the Science and Technology objectives. These were then sorted and analysed by a Project Steering Committee of pilot teachers, co-ordinators and other interested parties (see Appendix II). The examples are presented in this report, together with a commentary on their merits and the challenges they pose. The report should therefore be seen as an aid to teachers in the planning and delivery of CPVE, so they can determine their own approaches. There is no unique solution and this report does not attempt to present one.

SECTION 2 - WHY CORE SCIENCE AND TECHNOLOGY?

The Joint Board publications

8. The Joint Board publications [1,3,4], do not give a clear rationale for the inclusion of science and technology or indeed any area in the core, although such rationales have been expressed elsewhere [5,6]. This lack of rationale is responsible for some of the uncertainty felt by a number of teachers in this area.

9. There is little doubt that the science and technology component of the CPVE core presents a challenge to both course organisers and teachers. The key terms 'science' and 'technology' and their relationship are defined only by implication. Thus, it is only too easy for students and teachers to read requirements into the core that may not have been intended. Their own image of science and technology may get in the way. In our opinion, science and technology does have a valid claim to be part of the CPVE core and has aims that cannot be divorced from other aspects of core studies. Among other things it can provide an important focus for realising the aims in the crucial area of 'problem solving'. In the absence of a clear Joint Board rationale, this section endeavours to provide one.

Definitions of science and technology

10. In the absence of any formal definitions of 'science' and 'technology' the Joint Board aims 3 and 4 tend to suggest rather mechanistic models of scientific and technological method. They are not clearly related to each other, and appear rather 'specialist' to the student who is contemplating no further qualifications in the sciences or technology. As a starting-point the following definitions might be considered:

> 'Science is exploration and interpretation of man's environment'.

'Technology is a disciplined process using resources of materials, energy and natural phenomena to achieve human purposes' [7].

The quotations are not authoratitive definitions, but they represent a view that is thought to be helpful in the present context. Technology is more than the 'appliance of science'; science is more than the 'theory of technology'. They represent activities which may overlap and complement each other, such as systematic appraisal of evidence, design and production, but may have different goals and initial motivating factors.

The what? and how? questions

11. All students on a CPVE programme will have had some formal science education, and many have studied some broadly 'technological' subject - but students' prior experience and expectations in these curriculum areas will vary enormously within any teaching group. What has further study in these areas to offer all students? Some already 'know' more facts that they label science than they will ever need to know or use.

12. One of the fundamental principles of CPVE is that the curriculum should be tailored to match students' personal, social and vocational needs. Within this context, how can the Science and Technology aims be interpreted?

A problem-solving interpretation of the aims

13. One way of considering science and technology within the CPVE context is as 'real world' problem solving. To this end, students need to attain basic skills in the application of scientific method and technological processes to solving problems. For example, the problems might be:

    - Why doesn't the typewriter, tape-recorder, etc. work?

- What can be done to help infirm or elderly people who cannot operate taps, cooker controls, etc?

- How can someone be helped to reduce their heating bills?

14. The successful resolution of such problems, without the label of 'science and technology', can increase students' confidence and competence. The confidence of knowing 'how to proceed' with the likelihood of success can act as a major enabling and motivating force, leading to an appreciation of the importance of science and technology to themselves and society. With this approach it is neither desirable nor intended that teachers should attempt to give students a large body of scientific knowledge and competence in technological skills and processes. The emphasis is on tackling problems using a planned approach, with the appropriate technological processes and basic skills of scientific method as support.

15. Problem solving is fundamentally a reasoned, planned approach to understanding any task, technological or otherwise, and is not exclusive to science and technology. The basic steps can be considered to be, as shown in Figure 2:

i) identifying the problem;

ii) determining what the solution of the problem should be i.e. the specification;

iii) formulating possible solutions;

iv) producing and testing one or more of the solutions;

v) deciding if the best solution does what is required or if it needs modifying.

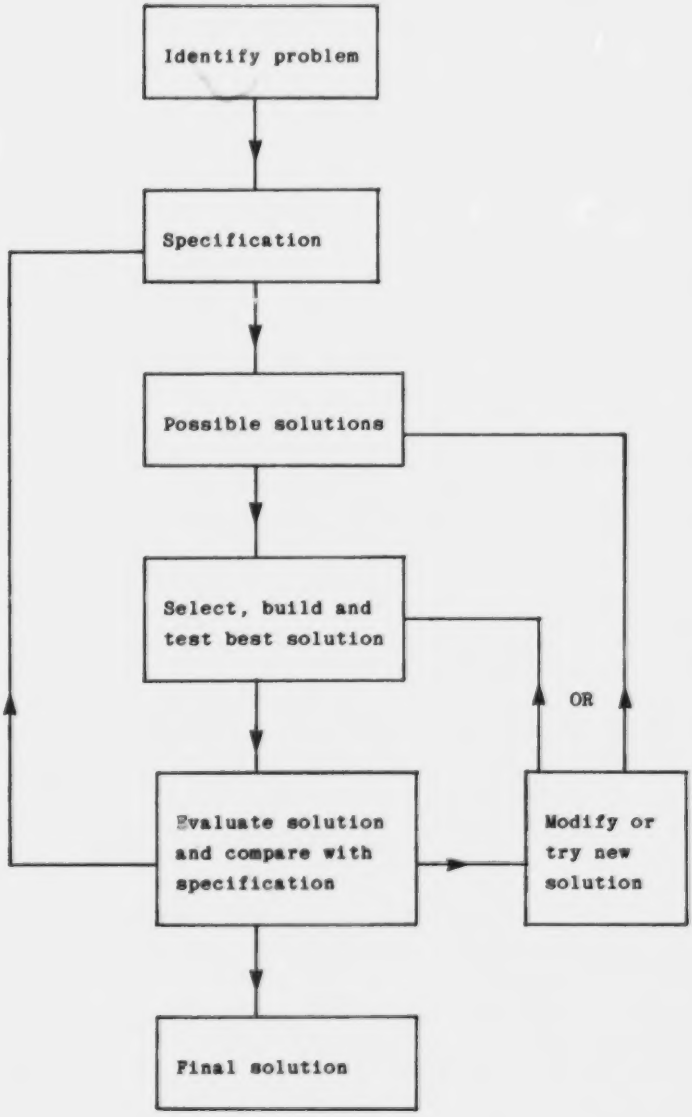

Figure 2 - Problem Solving

Relationship of problem solving to Science and Technology aims

16. The relationship of such an approach to the CPVE aims and objectives for Science and Technology (see Figure 1) can be considered to be essentially in terms of aims 2, 3 and 4. Figure 3 shows more details.

Awareness, knowledge and understanding, and competence

17. The problem-solving approach might integrate science and technology within the core area of Problem Solving. While some claim this an adequate coverage of the Science and Technology objectives, others might consider it to be incomplete in relation to the definitions given in paragraph 10.

18. Another way of looking at the interpretation of the CPVE aims for Science and Technology is in terms of:

    a) awareness of the interrelationships between science, technology and society;
    b) knowledge and understanding of science and technology;
    c) competence in tackling real problems.

    Within such a view, problem solving has a role but one which is not comprehensive.

Awareness

19. Aims 1 and 2 for Science and Technology call for opportunities for students to gain awareness of, and get to grips with, the interrelationships between science, technology and society. Some students may have followed courses explicitly addressing these issues; but even if they have, their growing maturity now makes it easier for them to see the importance and personal relevance of the issues. This does not necessarily call for any further direct teaching of science and technology, but rather for students to be given opportunities to use their existing knowledge and draw on new information as required to make sense of these interrelationships.

FIGURE 3

Problem Solving and its Relationship to CPVE Objectives

		OBJECTIVES
1.	Identification of the problem	2.1 and 2.2
2.	Possible solution and testing	2.3
3.	Practical and detailed working out of the planned problem-solving method	4.1 and 4.10
	For example:	
	- description of the problem and plan of action;	4.1 and 4.2
	- information gathering;	4.3
	- devising alternative solutions;	4.4
	- testing of solutions and selecting best;	4.5
	- planning, production and modification of best design;	4.6 and 4.7
	- evaluation;	4.8
	- maintenance;	4.9
	- safety.	4.10
4.	Devising solutions, testing and analysis	
	For example:	
	- an idea (hypothesis) requires a test or investigation;	3.1
	- techniques/skills and knowledge of equipment is needed for the test;	3.2
	- readings have to be taken, analysed and conclusions arrived at;	3.3 and 3.4
	- evaluation to check reliability;	3.5
	- possible generalisation and application to other situations;	3.6
	- safety.	3.10

20. Two aspects in particular can be claimed to have relevance for all CPVE students. First, an awareness that our society is dependent on the ability of technology to develop ever more powerful devices and systems that, in part, utilise scientific knowledge. Secondly, that although technology is a potent tool for satisfying human needs, the needs of different sections of society are not necessarily compatible. The needs of mankind, a nation, a government, citizens, shareholders, consumers, parents and children, may conflict - and the resolution of these conflicts has implications for students in their present and future roles in society.

21. The objectives of aim 1 (see Appendix I) propose that students should conduct an investigation in this awareness area. Ideally, such investigations might grow from real practical problems met and tackled by students, and some of the examples quoted in the next section take this form. They might however arise from a consideration of current events - items in newspapers. A range of resources is available to help students and teachers in this area.[8]

Knowledge and understanding

22. The extent to which students need to know and understand [9] science and technology as specialist areas of knowledge and activity will depend greatly on the nature and extent of their vocational commitments.

23. For students with a clear vocational goal in the technological field the reasons for 'developing facility in using scientific methods' (aim 3) and 'developing understanding of .... technological activities' (aim 4) may be obvious. Although the immediate relevance of some of the subject matter may be unclear, it is accepted as important as part of the preparation for progress. However, for many students with unclear or no vocational goals in this area, the prospect of 'more science' and 'more technology' can appear at best unappealing, especially if they have been unsuccessful in their earlier studies. Science in particular is, rightly or

wrongly, perceived as 'difficult' by many students (and teachers!), and trying to further conceptual understanding in this area without a clear purpose is a pointless exercise.

24. It may be that there are aspects of science and technology which are so important that no student should leave formal education without exposure to them. These may be called 'understanding for survival' and exist in such aspects as health, hygiene, domestic maintenance, road safety, uses of tools and materials. If CPVE students have missed out on these, their course should make suitable provision - preferably through practical investigation.

Competence

25. It is perhaps unfortunate that aims 3 and 4 in Science and Technology set up such formal and distinct models for scientific and technological understanding, as this might suggest that all students should carry out 'scientific investigation' to develop their scientific understanding quite distinctly from undertaking 'technological activities' to develop their technological understanding. In our opinion, both scientific investigation and technological activities are appropriate to the CPVE core, but not as isolated and separate activities. We see one of the overall aims of CPVE as developing in students the practical competence to tackle problems relating to the real world, rather than to artificially contrived situations restricted to science and technology.

26. The problem-solving approach outlined in paragraphs 13 to 15 can be seen as developing competence involving skills of communicating, planning, implementing and appraisal. The students bring to bear the ways of working of the technologist on problems that are real to them, using, where appropriate, the knowledge and ways of working of the scientist. Put simplistically, this suggests seeing aim 2 of Science and Technology as a sub-aim of the Problem Solving core area, and aims 3 and 4 as suggesting some appropriate strategies for realising aim 2 - solving problems by technological activity using science as appropriate.

Conclusion

27. There is no a simple answer to 'Why core science and technology?' It is suggested that the approaches described in this section should be used as a basis for discussion by the CPVE teaching team in a school or college on what seems to be the most sensible approach to adopt in their situation with their students.

SECTION 3 - STRATEGIES

The challenge

28. The strategies adopted in many pilots for covering the Science and Technology core objectives were limited by organisational constraints, such as a timetable that had been designed for another course and which was converted to CPVE at the last moment. This was probably inevitable since the pilot establishments did not know they would be running CPVE until the July preceding the September 1984 start. The constraints to be coped with included:

- a fixed timetable period or periods in a science laboratory every week for the year or some fraction of the year;

- timetabled access to a laboratory designed for only one science;

- only one teacher, whose main subject skills were in just one branch of science, allocated to covering the objectives;

- no science teacher or science resources allocated.

29. The challenge was, therefore, how to adapt the imposed organisational situation so that the Science and Technology objectives could be met.

30. Problems were encountered in relation to:

a) safety aspects in science laboratories and workshops with the 'requirement' for science and technology teachers to be present;

b) the traditional view of science leading to 'yet more school-like science', often for the very students who were previously unhappy with science;

c) the need for assessment and profiling perceived as dictating the adoption of a very fragmented approach to science and technology in order to make it easy to determine whether objectives have been met;

d) the need to ensure 'easy' progression for the student into other educational courses and employment on completion of the CPVE course, with pressures to make the subject as close to the 'O' level/BTEC level I unit etc. as possible;

e) considering the Science and Technology objectives as being independent of the rest of the CPVE course;

f) considering a class to be a coherent group all needing the same treatment.

Not all of the above are unique to Science and Technology. Some of the approaches that have been taken to meet these problems include:

a) Safety considerations mean that an appropriately trained teacher needs to be in attendance in laboratories and workshops, but it does not necessarily mean that all the students should be doing the same thing or even all attending at the same time. The concept of 'open access' or 'drop-in centre' or 'resource bases' has been used, enabling students to visit the supervised laboratory or workshop as they require.

b) Science and Technology objectives should be considered as a whole and as an integrated part of the entire CPVE course.

c) The needs of assessment for progression must be recognised, but not allowed to dominate the teaching/learning strategies adopted.

d) Progression in terms of the 'right' subject content is best ensured by the vocational studies and additional studies; the core areas should be regarded as part of general education for all.

e) Students have differing individual needs.

Possible strategies

31. The following are examples of possible strategies for covering the Science and Technology objectives. They start with the situation where organisational constraints restrict the range of activities available, and proceed to consideration of more open activities, such as assignments and projects.

32. a) Timetabled science/technology

Where a teacher is given a class and a timetabled slot to cover the Science and Technology objectives. Assuming 'open access' cannot be operated, possible strategies include:

i) a class-determined topic within which individuals or small groups carry out assignments;[10]

ii) teaching the science and technology needed to support vocational studies (e.g. Human Biology for caring studies, see paragraph 51), recognising that the whole class may not have common needs.

Problems can occur if the science is taught as though preparing the students for a GCE 'O' level[11] or similar examinations, because these are more content based than are the process-based objectives of CPVE Science and Technology. Some students may need such qualifications, so why not provide for them with Additional Studies[12] and design a

more appropriate programme for the Science and Technology objectives for all? Similarly, problems can occur if science and/or technology units/modules from vocational courses, e.g. BTEC level I units, are used. These also were not designed to meet the CPVE Science and Technology objectives and are probably best considered as Vocational Studies modules, with more appropriate programmes being designed for the CPVE Science and Technology objectives.

b) Within wide coverage assignments

Where assignments are used which span a number of core areas and vocational studies.

i) Students design or select assignments (e.g. an investigation of pollution, see paragraph 41), either individually or in small groups, and use the science facilities on an open access basis. This method could be part of a deliberate strategy to involve students in covering Science and Technology objectives without initially realising it, the assignments being checked against the objectives after the event. There may then be the need in some instances for extra assignment work to enable certain objectives to be covered.

ii) Students design, select or follow directed Vocational Studies assignments (e.g. in the preparatory module 'Materials Technology[13]). The Science and Technology objectives might then be met entirely within Vocational Studies, possibly without recourse to science laboratories or teachers. The danger here is that the Science and Technology objectives might not be covered. However, careful design of the Vocational Studies assignments could avoid this pitfall.

c) Within major projects

The term 'assignments' has been used in the previous discussion to imply relatively short duration activities, perhaps involving a few periods or weeks. Another possibility is a major project which covers the greater part of the CPVE year, perhaps including within it a number of assignments.

i) These could be within a mini-company, where Science and Technology objectives are covered as part of the activity of the company (e.g. a soft-toy making company, see paragraph 61). Companies involved in providing services or manufacturing almost invariably require 'research and development' and 'quality control' activities which can generally cover most if not all of the Science and Technology objectives. Assignments evolve as the students run the company and come across the need for such work. Almost invariably this will require open access facilities. Students might also be 'prepared' for the mini-company by being given, or led to evolve, suitable assignments.

There will be a need to check that individual students have covered the Science and Technology objectives and there may be a need for supplementary assignments.

ii) These could be part of a major activity, (e.g. residential session, see paragraph 65) with students covering different aspects either individually or in small groups. Again there will be a need to check that the objectives have been met by each student.

Logistics

33. There are issues common to all these strategies which need to be taken into account:

a) Planning, preparation and organisation. Some strategies involve more than others but for all this requires time.

b) A team approach by teachers. The strategy is not the sole responsibility of an individual teacher but part of an overall strategy for CPVE. As has been indicated in the FEU evaluation of the pilots, team meetings should be timetabled to ensure that all teachers can attend and participate.

c) Small student numbers at any one time. Individual or small group work is only really feasible and safe if the student group requiring the attention of a teacher is relatively small.

SECTION 4 - EXAMPLES

Introduction

34. Following requests to CPVE pilot co-ordinators and through the activities of members of the Project Steering Committee, a range of examples was gathered of ways teachers approach the Science and Technology objectives. The following discussion is based on these examples.

35. In this report we have concentrated on processes rather than content, i.e. the way teachers approach the objectives rather than a collection of 'worked' examples. The aim is to 'trigger' ideas to help teachers devise approaches to meet the needs of their own students.

36. The discussion of examples has been grouped under the classification of strategies considered in Section 3, namely:

- timetabled science and technology;
- within wide-coverage assignments;
- within major projects.

Timetabled science and technology

37. Timetabled science in the examples gathered by the project involved a total time allocation of the order of 10 to 20 hours, often in a block spread over about a term rather than the full year. Most of the time was timetabled in a science laboratory, with a science teacher.

38. One common approach was for the teacher to 'impose' a topic on the class and then involve students in carrying out a number of scientific investigations. In some cases these were experiments to specific instructions given by the teacher. The topic was often, though not always, loosely related to the vocational studies, the implicit assumption being that all students in the class are following the same vocational studies, and working at the same level.

From taught skills to a project

39. One pilot, for example, adopted the following sequence for a topic that involved one period a week for a year. The topic was 'colour'.

a) Basic skills taught and very straightforward worksheets used which gave diagram, method outline and layout of a results chart (e.g. worksheets on flame tests and coloured precipitates).

b) Work from published experimental guides (e.g. guides in glass making, both clear and coloured).

c) Discussion and design of simple experiments (e.g. experiments involving combining coloured lights and the colour of objects).

d) Discussion of relevant scientific theories (e.g. the theory of colour).

e) Open-ended project work initiated as a whole group activity; students undertaking particular sections of the work (e.g. project work involving dyes and paints).

f) Consideration of application to society (e.g. colour schemes for rooms).

g) Individually or in pairs, students then undertook projects on areas of work related to their own vocational studies. The area of work was chosen by discussion between teacher and student. This was seen as the most significant part of the sequence, the culmination of the course.

40. The above approach is based on an assumption that the students need to be 'taught' skills relevant to scientific, practical investigation and that without this basis they cannot design or carry out investigations successfully. Such an approach might be thought to be implied by the CPVE objectives. Indeed this approach enables correlation

between the students' activities and the objectives more easily than most other approaches.

Students designing assignments

41. A less formal approach involves students more in the design of the assignment work. One pilot supplied the students with questions on the topics of materials, food and pollution, supported by outline details of possible experiments. The students were asked to devise their own assignments. They were given the following guidance:

> 'You may use information from the Science Department or the Library or any other source. You are strongly advised to contact outside establishments for any help they might offer. You must attempt some practical work and a lot of advice on this is given. You must plan your course of action and when you want to do practical work you must give at least one day's advance warning so that the apparatus can be got ready'.

Some students took the opportunity to evolve their own assignment, others just wanted to do the experiments for which details were given.

42. The following are some of the questions supplied on pollution and outline details of possible experiments.

Question: What is pollution? How does it arise? What are particular pollutants? What are the effects of such pollution? How is pollution detected? How is it tackled?

Experiment: Use a pH meter to find the pH of collected rain water. What is pH? What causes the pH of rain? Is this a good or bad area? Why? You must take readings over a long period of time. Does the value vary? If so, why?

Experiment: Take a beaker which you have weighed. Into it put a small quantity of rain (100 ml). Boil

away the water and reweigh the beaker. What do you find? Why is this? Is this a good or bad area? Why? Take rain from many different areas. Do your results vary? Why?

43. Timetabling can prove to be a major constraint with regard to the content of such assignments; for example, the students might be inexperienced at planning practical work and require more direction than expected.

Vocational links

44. Linking the topics considered with vocational studies can be motivating for the students, but a word of caution. The link between topics suggested to students and their vocational studies can be tenuous. Even where there is a link with the topic, the link between the actual assignments and the occupational activity a student could undertake may be even more tenuous.

45. For example, students with Retailing as their vocational choice were presumed to be interested in food additives and therefore the following assignments were suggested:

a) a consideration of labelling on goods in a retail store and whether additives were indicated;

b) reading and discussion of the pros and cons of additives;

c) an investigation of the effect that colour has on people's choice or enjoyment of food;

d) extraction and identification of the colouring additives in custard powder.

46. The assumption that students of Retailing would see relevance to their vocational studies in the extraction and identification of colouring additives in custard powder

could be incorrect. Labelling and the 'ethics' and merits of additives, however, might be relevant to students who may become involved in selling such goods. Their main interest is likely to be how to sell custard powder, rather than chemical analysis. Any factor which bears on the selling could be worth investigation. It would, for example, be possible to devise an assignment on how relative positioning on a supermarket shelf affects sales. Such an assignment would involve constructing a hypothesis designing experiments, carrying them out and analysing the results. The moral is to prepare assignments but discuss their relevance with the students before imposing them.

Environmental and social issues

47. Not all science and technology has necessarily to involve practical activities. One pilot, for example, used a slide presentation to compare low technology societies, our life 100 years ago and our society today to highlight the benefits of developing technology and the related environmental, social, economic and political problems. Particular emphasis was placed on the increasing energy requirements of developing societies and technical and non-technical solutions were differentiated, e.g. famine relief by giving direct sustenance or relief as aid to develop agriculture. A BBC Horizon programme 'What Ever Happened to the Energy Crisis?' was used as a trigger for discussion. The slide presentation and related discussion were seen as meeting aim 1 and objective 1.1, with discussions of 2.1, 2.2, 2.3. The BBC programme was seen as meeting aim 2, objectives 2.1 to 2.4.

48. Such activities could well have a place, giving a broader view of science and technology than might be encountered in a purely practical, assignment-based approach. There could be integration with aspects of the Industrial, Social and Environmental Studies core area.

Within wide coverage assignments

49. Science and Technology assignments invariably relate to objectives in other core areas and quite often to those in Vocational Studies. For example, the topic and assignments on colour referred to in paragraph 39 resulted in the coverage of objectives shown in Figure 4. One possible strategy, therefore, is deliberately to use assignments as the main vehicle for covering objectives in a wide range of core and vocational studies.

Examples of investigations

50. The following are some examples of topics for investigation:

Bottle-opener for weak or disabled people.
A trolley board for a handicapped person.
Tap or control grips for deformed arthritic hands.
An alarm system for an old or handicapped person.
Digging guide for a blind gardener.
Manoeuvrable wheelchair/wheelchair design for a purpose.
Wheelchair ramp.
Toys for local hospital - jigsaws, pull-along toys.
Nutcracker for children's use.
Children's climbing frame.
Instrument for removing screw bottle caps.
Instrument for retrieving books or boxes from high shelves.
Animal trap to trap without harm.
Hardness testing machine.
The effect of noise on performance in an office.
Safety in the office/shop.
Suitability of floor coverings in a leisure centre.
Running and maintenance of a swimming pool.
Stocktaking and ordering system for a supermarket.
The effects of introducing new technology in a local town.

Objectives / Assignments	Science and Technology												Communication Numeracy							Practical Skills					Problem Solving				Social	Creativity
	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.10	2.3	3.1	3.2	1.1	1.2	1.3	1.6	4.1	4.4	1.5	1.5	1.6	1.7	1.8	1.9	1.3	1.4	2.5	2.13	1.1	3.2
Coloured substances					✓		✓	✓	✓				✓	✓	✓	✓				✓	✓		✓		✓			✓	✓	
Coloured flames					✓		✓	✓					✓	✓		✓				✓	✓				✓		✓	✓	✓	
Glass making					✓		✓	✓					✓	✓		✓		✓	✓	✓	✓			✓			✓		✓	✓
Theory of colour	✓				✓								✓	✓		✓				✓									✓	
Chromatography	✓				✓		✓	✓					✓	✓		✓		✓		✓	✓	✓							✓	
Dyes					✓		✓	✓					✓	✓		✓		✓	✓	✓	✓	✓							✓	
Fastness of dyes		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓					✓				✓	✓	✓		✓	
Paints		✓		✓	✓						✓		✓	✓		✓				✓	✓	✓					✓			

FIGURE 4

Coverage of CPVE Core Objectives by an Assignment on Colour

Vocation-linked assignments - Caring

51. While the examples given in the preceding paragraph might interest students because of their social dimension or the challenge they offer, some pilots devised assignments which directly link with, and support, vocational studies. In many instances the assignments were backed up with the teaching of specific knowledge and skills. For example, CPVE students taking 'community care' within vocational studies were involved in the following scheme:

a) Human biology was studied and included aspects of reproduction, child development and ageing, together with problems and their causes, especially in relation to child or pre-natal development.

b) Students thinking of embarking on a career in the caring sector often need catering skills, so these were also developed. A project was undertaken involving the study of various diets for all ages, culminating in the organisation of a luncheon for employers from their work experience placements. This included a study of food science and additives and health and safety in food preparation, as well as estimating quantities, costing, and communication and social skills.

c) A particular aspect of the course was the close association of the CPVE group with a handicapped couple. This involved a visit to their home to see at first hand the problems encountered and to study the aids available. Some students worked in a handicapped holiday home and studied the aids for 'patients' and staff. A subsequent development was a technological project where students designed a trolley board for a handicapped person. This involved a scientific study of body shape, pressure points, stress, wear, fabrics and manoeuvrability. Another project involved a study comparing differently designed wheelchairs.

d) The CPVE community care group was linked with a group following vocational studies in Technical Services and both were given the task of designing an alarm system. This opened up the area of electronics and suggested the idea of linking the alarm to a home computer.

52. Assignments involving designing aids for disabled people were common to a number of pilots, particularly those concerned with vocational studies involving caring. One pilot has used a kit 'Design with disabled people'[14]. The kit aims to increase young people's knowledge of disabilities and related problems, to provide students with the opportunity to recognise the needs of certain disabled people and to fulfil these needs by designing and making aids. The kit includes:

- information on how and where to contact the disabled person;

- worksheets to increase the student's awareness of disability and related problems;

- a procedural path for the design process, set out in the form of a workbook which takes the student step-by-step through the problem solving;

- case studies, resource lists, posters and slides.

Vocation-linked assignments - Business and Administration

53. Many students follow vocational studies in Business and Administrative Services and the need to design assignments which involve both Science and Technology objectives and Vocational Studies objectives has presented problems to some pilots. Many assignments can, however, stem from a consideration of the office environment. The following are two examples of possible assignments.

a) How does noise affect work performance? An investigation could take a variety of forms within an office environment, e.g. the effect of the volume of noise on performance, the effect of the nature of the noise (people talking, aircraft etc.). The choice of the task to be undertaken, the way the task is carried out and the measurement of the subject's performance all need careful consideration. Further work could involve examining the regulations[15] governing noise at work and an investigation of methods of noise reduction.

b) Is the office a safe place to work? This could involve a consideration of safety with electricity, the possibility of radiation from VDU screens, the possibility of office air conditioning making people ill, the movements resulting in toppling filing cabinets, or the design of fire exits and gangways etc. The safety with electricity could involve a variety of simple experiments to familiarise students with the function of fuses and the importance of fitting the correct fuse, the implications of overloading a circuit, the importance of earthing and the danger of touching electrical equipment with wet hands. In addition they could carry out surveys in offices, collect and read any relevant information and try to decide for themselves how safe the office is.

Vocation-linked assignments - Recreation Services

54. A number of assignments have been designed for use with students following vocational studies in the area of Recreation Services, again based upon a consideration of the environment in which they would operate. An apparently simple, but in fact rather complex, assignment involved a consideration of the suitability of various floor covering materials for specific leisure areas. Wearing qualities, slipperiness, porosity, susceptibility to denting, resistance to staining, flammability, etc. are all properties that need to be taken into account after careful

analysis of what is required. In addition there is a consideration of what materials are available, their cost, installation and maintenance. Another assignment could consider the running and maintenance of a swimming pool; the filtration system, the heating system, health problems, safety, etc.

Vocation-linked assignments - Retail

55. Examples of assignment topics with relevance to the retail trade include:

a) Development of a stock control policy for a supermarket, with a consideration of a computer-organised system of stocktaking and ordering. This can involve a consideration of the impact of modern technology on workers.

b) Development, following a survey, of a policy with regard to the location of the various types of goods in a supermarket (see paragraph 46).

c) A consideration of the shop as a safe place to work (similar to paragraph 53).

Vocation-linked assignments - Production

56. Assignments concerned with making objects inevitably involve a consideration of production methods and there is a case for those students interested in production working together with other groups on assignments, e.g. a Caring group working on the requirements, design, production and testing of a wheelchair ramp. Retail students and Business and Administrative Services students could also find a role. Such assignments might well develop into mini-companies (see paragraphs 59 to 64).

57. One pilot based a project for a diverse group of students on a consideration of how new technologies have been introduced in various places of work in their town. This involved the students in a series of visits - to a word processing bureau, a building society which used computerised administration, a supermarket with a computerised stock control system, a company using computer aided design in production and a company using computer controlled machines for cutting materials. Students were expected to visit at least two of these companies, compare ideas, attempt to reach a group consensus and produce a group report.

Using wide-coverage assignments

58. Basing a strategy on the use of assignments of the types outlined in the above paragraphs raises a number of issues for the teacher.

a) An assignment usually involves more than just one area of the core, more than the resources of just one 'subject', and more than one teacher. It therefore has to be part of the strategy for the entire CPVE programme and the responsibility of the teaching team as a whole.

b) Students do not often put up assignment ideas themselves, teachers need to have ideas which they can use to trigger students into action.

c) Teachers in the team have to act in the role of advisers/consultants to students, rather than in a formal teaching role.

d) Many assignments have resource implications, often not always easy to forecast. For example, many may require miscellaneous pieces of wood, metal, plastic, various screws, nails, fasteners, etc. Students may need to use a laboratory or workshop for a protracted period of time.

Within major projects

Within a mini-company

59. A number of pilots operated mini-companies as a way of covering many core and vocational studies objectives. The following outlines an approach adopted by one pilot. Since the Science and Technology objectives were seen as fundamental objectives, likely to occur in any vocationally orientated assignment, teachers did not design assignments to meet the objectives but rather considered retrospectively which objectives had been met after the students had completed some assignment work. By keeping a record of the objectives covered, weak areas were highlighted and specific assignments designed to cover them.

60. a) A Technical Services Company

A small business is run as part of a Technical Services vocational studies. The business is concerned with the service and repair of electrical and electronic equipment. Associated with the business is a bank of 'satellite assignments' concerned with setting up the management, finance, record keeping, testing, fault-finding and repair, transport, advertising, etc. These assignments are often in the form of task sheets to aid the students in working their way towards the operation of their company. Within each of these some Science and Technology objectives will be covered.

61. b) A Toy Rabbit Making Company

Another mini-company activity is soft toy making, undertaken as part of a Business and Administrative Services vocational studies. The following extracts from a student task sheet illustrate how a crisis developed and how, in having to cope with it, the students covered many Science and Technology objectives.

'You and your CPVE group have already started in business making soft toys. At present you are producing "lying-down" rabbits, using a template which has been drawn by a member of your group.

Production seems to be a bit "slap-happy", since you have only just started to make this particular product, and probably in your understandable rush to "get into production" you have not yet developed a proper system.

You have managed to sell a few of your rabbits but you now have a letter of complaint. My advice is: stop and think of the possible consequences of NOT establishing a proper system for the production of rabbits. (The letter is a letter of complaint about the rabbits looking like pigs and the poor construction which was causing them to fall apart.)

You will have to look again at your whole production process from many points of view, and you will have to produce a plan which will be as near "watertight" as possible.

In other words, you must approach the problem scientifically. Set out your new strategy and approach, and draw up the "Rabbit Plan" which everyone will be able to understand, and which everyone will be required to follow. Teachers' Guidelines: Your CPVE group may now be able to go ahead on its own without any further help and guidance. However, if you feel you need more advice, the suggestions outlined below may be helpful as a rough checklist for you to follow.

a) Redraw the template, or buy a pattern. If you draw another template, perhaps you should draw an 'exploded' plan of the rabbit with all its sections 'poised' over, but not attached to, their correct positions.

b) Construct a flow chart to show the sequences in which all the sections of the rabbit should be (i) made and

(ii) assembled, ensuring that first class quality is maintained throughout the production process.

What needs to be done if quality is not maintained should be indicated in the form of questions requiring yes or no answers.

c) Decide on the type and texture of the materials required (e.g. glass eyes or nose, fire-resistant materials) in relation to their cost and safety.

d) Construct the first prototype and allow one of the group to test it on a small child, allowing the child virtually to tear it to pieces.

e) Monitor production, rejects, quality and general efficiency regularly, and do not be afraid to call Board Meetings to discuss matters of policy in the light of your results.

f) Ensure that at least two members of the group have a good working knowledge of the machines used to produce the rabbits - the machines will need to be serviced and maintained regularly.

g) Draw up a Code of Safe Practice for people using the machines and equipment on your business premises.

h) In the light of progress made, consider possible "spin-off" benefits for your business. For instance, would a "Repair service for sick toy animals" be a feasible proposition. Always try and think of further future developments'.

62. The above is an example of how students, in carrying out a project, ran up against real problems which required modification of their original plans. By 'going wrong' and then correcting, they probably learned more than if the teacher had given them the 'correct' procedure at the beginning.

63. Many, if not all, the Science and Technology objectives could be covered in 'toy rabbit making' (see Figure 5).

64. The operation of a 'company' inevitably involves many CPVE objectives. Thus, for instance, in considering the purchase of materials, the types and quantities of materials have to be worked out, bulk buying and discounts examined, suppliers located, their costs and collection or delivery services compared, payment methods determined and, finally, orders made out. Another group of objectives could be covered by considering fire hazards and fire fighting equipment for the company.

FIGURE 5

Science and Technology Objectives in 'Toy Rabbit Making'

	OBJECTIVES
Handling the letter of complaint and its outcomes	1.1, 1.2 and 1.3 1.3
Considering what the customer wants	2.1, 2.2 and 2.3
Working to a production plan and using a template	2.4
Designing the tests for the prototype	3.1
Testing the prototype and analysing the results	3.2 to 3.6
Designing the rabbit and the production plan	4.1 to 4.8
Maintenance during production	4.9
Safety	4.10

A major task - a residential session

65. Residential sessions offer the opportunity for students to cover core objectives not only as a direct consequence of the main topics of the sessions but also in planning and organising for the session itself. Some of the objectives covered could be in the Science and Technology area. Assignments associated with a residential session might then include:

Choosing the residential - type, distance, student numbers, time, cost.

Fund raising - means of, organising of.

Booking accommodation - letters, telephone, information required, invoice.

Transport - alternatives, costs, time.

Finances - collections, safe-keeping, paying for activities.

Publicity/reporting - informing participants, informing staff, recording activities.

Timetable/activity programmes - specialist staff requirements, booking, timetabling.

Catering - menu, ordering food, purchasing, preparing.

Duty roster/discipline - code of responsibility, penalties.

Insurance and parental consent - legal requirements, cost, distribution of information, collecting consent forms.

Equipment - basic necessities, specialist equipment, booking of, collecting/returning.

Staffing - specialist requirements, booking of.

Survey of local housing - types, materials used, heating, efficiency, alternatives.

Survey of local industry - types, local employment, effect on environment.

Survey of local entertainment - types, local trends, social effects.

66. As will be apparent, Science and Technology objectives can often be covered in activities which are not obviously labelled as science and/or technology. Thus, for example, the survey of local housing can lead to subsequent assignment work on materials and heating, the catering element to work on diet and food preparation, the survey of local industry to a consideration of pollution, publicity/reporting to photographic work, etc.

SECTION 5 - ISSUES

Strategies

67. There is no one recipe which is 'right'. Students and situations differ and each situation needs specific consideration. It was this point on which the Project Steering Committee felt very strongly: teachers should design strategies for their students and their situations and not assume that a strategy designed for another situation or group of students will be appropriate.

68. Three main types of strategies have been described. One was within timetabled science and technology periods. This tends to involve assignments which are often grouped around a topic. In some instances this is supplemented by 'lessons' where theory or basic skills are developed, or where implications of science and technology are discussed. This method, although fitting comfortably within the conventional timetable, does have disadvantages - there is often a lack of meaningful integration with the rest of the CPVE programme. Other strategies involve assignments or major project activities, such as mini-companies, which span large areas of core and vocational studies. To operate such assignments or projects so as to allow individuals or small student groups to work in their own way requires a degree of open access to resources. This raises administrative problems but can be an exciting challenge. There is, however, the problem that individual students may not cover objectives and might not always gain a wide range of experience. One possibility is to combine such assignments or projects with some timetabled sessions, to draw attention to the wide-ranging implications of science and technology.

A checklist

69. The following checklist of questions may be helpful when plans are being made for science and technology. The answers to the questions, and the implications of the answers, should assist in the design of an effective strategy.

1. What do the students want and need?

   a) Would they reject anything labelled as science and/or technology or very obviously appearing to be so?

   b) Do they need science and/or technology because of the progression associated with their vocational studies?

   c) Do they need science and/or technology appropriate for the educated citizen?

   d) Have they a variety of backgrounds in science and vocational aspirations, hence a variety of wants and needs?

   e) Why do they need to develop basic science/ technological skills? Because.....

   f) Why do they need to acquire some basic knowledge and understanding of science and technology? Because.....

2. What are you able to operate?

   a) Open access to laboratories/workshops, equipment and specialist staff?

   b) Only timetabled sessions with such resources?

   c) A mixture of open access and timetabled access to the resources?

3. Can you plan and implement coverage of the Science and Technology objectives:

   a) Integrated with the other core objectives?

   b) Linked or integrated with vocational studies?

4. What approaches are possible for the different aims/objectives?

   a) A student-centred rather than teacher-centred approach?

   b) Assignments rather than 'formal' teaching?

   c) Assignments plus some teaching or basic skills/ knowledge?

   d) Assignments plus some class sessions on the implications of science and technology?

   e) Assignments predominantly within the science and technology area or ones covering a wider range of objectives?

   f) Sessions labelled Science and Technology, or some related title, or partial or complete integration of the Science and Technology objectives within (i) vocational studies, (ii) some wide-ranging project or activity, such as a mini-company?

   g) A mixture of approaches?

Advice from pilots

74. In conclusion it is worthwhile repeating some of the advice given to us by the pilots in the FEU evaluation report CPVE in Action.[2]

   - Don't separate core and vocational studies.

   - Construct a flexible timetable.

   - Build a team.

   - Timetable team meetings.

- Learning is more important than teaching.

- Listen to students and acknowledge their different needs of pace and direction.

- Check your procedures and practice to ensure they minimise discrimination and maximise equality of opportunity.

- Don't expect anyone else to give you all the answers.

- Don't be afraid to make mistakes!

The Project Steering Committee would add one other:

- Don't take too narrow a view of what constitutes science and technology.

REFERENCES

1 The Certificate of Pre-Vocational Education, Consultative Document, The Joint Board for Pre-Vocational Education, May 1984.

2 CPVE in Action, FEU, November 1985.

3 The Certificate of Pre-Vocational Education, Part A, The CPVE Framework and Criteria for Approval of Schemes, The Joint Board for Pre Vocational Education, January 1985.

4 The Certificate of Pre-Vocational Education, Part B, Core Competences and Vocational Module Specifications, The Joint Board for Pre-Vocational Education, January 1985.

5 Progressing to College: a 14-16 Core, FEU, 1985.

6 Science Education 11-16: Proposals for Action and Consultation, Secondary Science Curriculum Review, 1983.

7 Black, P and Harrison, G, In Place of Confusion: Technology and Science in the School Curriculum, Nuffield-Chelsea Trust and NCST, 1985.

8 For example: Science in Society, Association for Science Education, 1978 onwards; Science in a Social Context, Association for Science Education, 1980.

9 The terms 'knowledge' and 'understanding' are being used in the same way as in the Biology, Chemistry and Physics Draft Grade Criteria reports of SEC (1985) and can be considered to refer to the 'content' of the subjects.

10 Examples of this approach are evident in primary schools. The Schools Council 5/13 publications, Macdonald Educational 1973, illustrate this type of approach.

11 This may change with the introduction of GCSE.

12 The term 'Additional Studies' is used as defined by the Joint Board in reference 3.

13 The Certificate of Pre-Vocational Education, Part C, Preparatory Module Specifications, The Joint Board for Pre-Vocational Education, May 1985.

14 Design With Disabled People, School Concern Project/CSV 1981, published by Community Service Volunteers (237 Pentonville Road, London N1 9NJ).

15 Code of Practice for reducing the exposure of employed persons to noise, Health and Safey Executive, HMSO, 1972.

APPENDIX I - CPVE CORE COMPETENCES: SCIENCE AND TECHNOLOGY

It is intended that the aims and objectives presented under this heading should be developed throughout an approved CPVE course and should allow students to acquire, practise and transfer their achievement within a variety of relevant and integrated activities.

MAIN AIM

To develop understanding of science and technology, and their relationship to everyday life, and competence in the application of practical, scientific method.

AIM 1: APPRECIATION OF SCIENCE AND TECHNOLOGY

To develop appreciation of science and technology, their relationship with society and the environment and awareness of moral and legal implications by

1.1 drawing up a brief for an investigation or project involving an example of the interrelationship between science and technology, society and the environment

1.2 conducting the above investigation using appropriate information sources and research methods

1.3 presenting a report which takes into account environmental, social, economic, legal and political factors relevant to the investigation.

AIM 2: APPLICATION OF SCIENCE AND TECHNOLOGY TO PROBLEMS

To develop a critical approach and an ability to apply principles, reasoning and skills to problems and issues of everyday life by

2.1 differentiating between problems with technical and non-technical solutions

2.2 identifying and describing the nature of simple scientific and technical problems

2.3. suggesting and selecting alternative explanations, causes or solutions - by forming hypotheses, using models, using analogies

2.4 following technical instructions and working to a plan.

AIMS 3: SCIENCE

To develop facility in using scientific methods to conduct investigations and evaluate their outcomes by

3.1 planning investigations and designing experiments in order to test explanations

3.2 selecting, assembling and using scientific and technical apparatus and instruments appropriately

3.3 observing and recording data and procedures systematically and accurately

3.4 interpreting and evaluating data and results of experimental work in order to make deductions and draw conclusions

3.5. evaluating and investigating experiments, and procedures - identifying sources of error and explaining their significance, devising and using simple tests to check the validity of measurements and experimental work

3.6 generalising, as and when appropriate, from experimental results

3.7 identifying the scientific facts underlying investigations undertaken using appropriate terminology and conventions

3.8 identifying the scientific laws, principles and generalisations underlying investigations undertaken using appropriate terminology and conventions

3.9 demonstrating understanding of scientific laws, principles and generalisations by applying knowledge gained in one context to other contexts

3.10 satisfying all necessary health and safety requirements in planning and conducting investigations.

AIM 4: TECHNOLOGY

To develop understanding of the processes of planning, implementing and evaluating technological activities by

4.1 drawing up a design brief from given requirements and constraints, including time and cost limits

4.2 drawing up a plan of work, including allowance for information search, design execution, testing and evaluation of process or product, reporting and timetabling of project

4.3 collecting relevant information, identifying assumptions and approximations made on the basis of incomplete data

4.4 producing alternative tentative solutions, including reference to both original ideas and solutions tried and tested elsewhere

4.5 comparing alternatives systematically, selecting the best alternative(s) for future development

4.6 drawing up final design(s), investigating and evaluating suitable materials and processes as necessary

4.7 making, modifying or modelling as appropriate to test the design

4.8 evaluating the outcome(s) in terms of the design specifications and the processes involved and suggesting further development as appropriate

4.9 demonstrating understanding of the importance of maintenance procedures

4.10 satisfying all necessary health and safety requirements in planning and conducting activities.

APPENDIX II

Project Steering Committee

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Other sources of information

In addition to many papers contributed by members of the Steering Committee, particularly useful papers were received from:

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Objectives

The objects for which **The Further Education Unit (FEU)** is established are to promote, encourage and develop the efficient provision of further education in the United Kingdom and for that purpose:
a) to review and evaluate the range of existing further education curricula and programmes and to identify overlap, duplication, deficiencies and inconsistencies therein;
b) to determine priorities for action to improve the provision of further education and to make recommendations as to how such improvements can be effected;
c) to carry out studies in further education and to support investigations of and experimentation in, and the development of further education curricula and to contribute to and assist in the evaluation of initiative in further education;
d) to disseminate and publish information and to assist in the dissemination and publication of information about recommendations for and experiments and developments in further education.